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ABSTRACT

This pamphlet reviews five reports that highlight an emerging consensus among researchers about the value of systematically incorporating cognitive instruction into the elementary school curriculum. First is a comprehensive framework by Robert J. Marzano and C. L. Hutchins for an integrated approach to thinking skills that has been developed and tested by the Mid-Continent Regional Educational Laboratory. Next are three research studies conducted at the elementary level that reveal the efficacy of cognitive instruction both in raising achievement levels and in closing the gap between high and low achievers. These studies focus, respectively, on metacognitive strategies of first- through third-grade teachers, writing instruction for second-graders, and mathematics instruction in kindergarten. The final selection describes the development and implementation of a successful cognitive instruction program for kindergarten through third grade in an urban school district. (TE)

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R·E·S·E·A·R·C·H roundup

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Teaching Thinking Skills

Thomas I. Ellis

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RESEARCH roundup

Volume 4, Number 3 April 1988

Teaching Thinking Skills

Thomas I. Ellis

The proliferation of information technology in recent years is changing our society in ways we are only beginning to understand. Although the long-term effects of these changes are far from clear, most educators agree that today's students will face a world that places a special premium on cognitive skills. Accordingly, instructional planners at the elementary level face the challenge of incorporating cognitive or "thinking" skills into their curricula.

Many educators who are convinced that schools need to teach "thinking" are nevertheless uncertain about what specific skills are involved or how to go about developing them.

The findings of recent research on cognitive processes are changing our perception of the thinking and learning process in ways that have significant implications for educational planners. What we call "intelligence," once thought to be a more or less innate, stable quality measurable by IQ tests, is being shown to be a questionable concept that covers a wide range of skills, habits, and attitudes, most of which can be improved by appropriate changes in the context and methods of instruction.

The discovery that thinking can be improved by instruction obliges educators to question the assumption, seldom articulated but often incorporated into practice, that schools are called upon to screen students and establish varying curriculums and opportunities for the "talented and gifted," the moderate achievers, and the low achievers. The implication is that their differences in achievement reflect differences in innate capacities. The research shows otherwise. For example, in the three comparative studies reported here, the net gains in achievement for the low-achieving students were higher, in all three cases, than the gains made by high-achieving students.

Another discovery, deriving from advances in information theory, is that thinking skills across the curriculum follow the same general principles of information processing. Thus the so-called "higher order thinking skills" are actually hierarchical combinations of more basic skills. Taken together, these insights from cognitive research promise to reshape many of our operating assumptions about curriculum and instruction.

Instruction in higher order thinking skills has traditionally been regarded as an adjunct to secondary and even postsecondary instruction. By emphasizing the continuity of basic and higher order thinking, however, these more recent cognitive insights are causing both researchers and practitioners to take a new look at the elementary level, since basic habits of thought are established at an early age and are difficult to change later on.

The five reports reviewed below highlight an emerging consensus among researchers about the value of systematically incorporating cognitive instruction into the elementary curriculum. First is a comprehensive framework for an integrated approach to thinking skills that has been developed and tested by the Mid-Continent Regional Educational Laboratory.

Next are three research studies conducted at the elementary level that reveal the efficacy of cognitive instruction both in raising achievement levels and in closing the gap between high and low achievers. These studies focus, respectively, on metacognitive strategies of third-grade teachers, writing instruction for second-graders, and mathematics instruction in kindergarten.

The final selection describes the development and implementation of a successful cognitive instruction program for kindergarten through third grade in an urban school district. This model program is especially useful as a guide for elementary principals who seek to initiate such a program in their own schools.

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1 Marzano, Robert J., and C. L. Hutchins. *Thinking Skills: A Conceptual Framework.* Aurora, Colorado: Mid-Continent Regional Educational Laboratory, 1985. 64 pages. ED 266 436.

Until recently, most of the theoretical activity related to instruction in thinking skills consisted of creating, and arguing for, various taxonomies of discrete skills, of which Benjamin Bloom's (1956) is the best known and most influential. One practical result of this tendency has been a proliferation of "add on" programs, geared to training students in these various skills.

Marzano and Hutchins say this approach is fundamentally misguided because it fails to take account of much of the current cognitive research derived from information theory. This research suggests that knowledge is fluid and generative—that as we learn more, we reshape or restructure what was previously learned. Accordingly, Marzano and Hutchins suggest that we need to reconceive current curricular and instructional practice so as to incorporate thinking skills into every aspect of school experience.

Based on John Anderson's seminal 1983 book, *The Architecture of Cognition*, Marzano and Hutchins present a model that unifies current research and theory with a new understanding of the traditional notion of content and with a different approach to instruction. Anderson's thesis is that the majority of the cognitive skills considered relevant to academic success can be categorized into three hierarchically related groups: content thinking, reasoning, and learning to learn.

Content thinking embraces three kinds of knowledge: declarative knowledge deals with mastery of concepts, propositions, and relationships; procedural knowledge refers to the ability to break a complex process into its component steps; and contextual knowledge involves determining situations in which specific information and skills should or should not be used. These kinds of knowledge are cumulative; that is, declarative knowledge is prerequisite to procedural knowledge, which in turn is necessary for contextual knowledge.

Reasoning consists of transferring content (that is, effective storage and retrieval of declarative, procedural, and contextual knowledge); matching these elements with what is already known; and restructuring, or producing new knowledge and solving new problems by comparison with and synthesis of the old.

Learning to learn, or metacognition, includes attending (paying attention), setting goals, monitoring attitudes, and self-evaluating the thinking processes. These skills, like others, are progressive; paying attention is prerequisite to setting goals, which likewise forms the basis by which students can learn to monitor their attitudes.

Marzano and Hutchins conclude with a discussion of restructuring issues considered necessary for the systematic teaching of thinking skills: specifically, how each of the three thinking skill areas necessitates fundamental changes in schools, testing, evaluation, and the integration of instruction. Because of the hierarchical interdependence of these skills, this model has significant and far-reaching implications for curriculum and instruction, especially at the elementary level, where the rudamentary "building blocks" of these skills must be effectively taught.

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The ERIC Clearinghouse on Educational Management, one of several such units in the system, was established at the University of Oregon in 1966.

Prior to publication, this manuscript was submitted to the National Association of Elementary School Principals for critical review and determination of professional competence. The publication has met such standards.

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2 Moely, Barbara E., and others. *Relationships Between Teachers' Cognitive Instruction and Children's Memory Skills.* Paper presented at the biennial meeting of the Southwestern Society for Research in Child Development, San Antonio, Texas, March 6-8, 1986. 28 pages. ED 272 294.

Metacognition, or thinking about thinking, is often regarded as having no place in a primary curriculum, since we assume that children in grades 1 to 3 are too limited in their cognitive skills to understand, or make use of, anything other than direct instruction. Not so, according to Moely and her associates. The aim of their research project was to determine whether individual differences in the use of memory and problem-solving strategies by elementary school children are related to teachers' use of strategy suggestions in the classroom.

Thirty-eight students—including high, average, and low achievers from first through third grade—were selected from classrooms of eight teachers who had been observed frequently suggesting cognitive processes and strategies to children. For comparison, twenty-six children were chosen from classrooms in which teachers rarely made such suggestions.

In individual sessions, children were given a free recall task. They were then trained in an organizational strategy for free recall and

assessed for maintenance of this strategy. The strategy involved sorting and categorizing forty line-drawings from eight conceptual categories.

All the children showed improved recall performance and increased ability to apply the strategy immediately after training. On a later test trial, however, performance varied from group to group. While high-achieving children from both groups showed excellent maintenance of the strategies in which they had been trained, those average and low achievers whose teachers frequently suggested cognitive strategies showed superior maintenance of these cognitive strategies in comparison with similar children whose teachers rarely made strategy suggestions. This difference held for recall performance, for recall organization, and, among younger children, for category sorting during the study. The children whose teachers often suggested cognitive strategies were better able to verbalize an accurate recollection of their instruction.

The research sample, as the authors admit, was too small to allow any categorical conclusions to be drawn, but the study strongly suggests that children of moderate and lower levels of achievement—those who, unlike high-achieving students, have not already internalized effective cognitive strategies—can profit from regular metacognitive suggestions by their teachers.

3 Jackson, Rex. *The Effects of the Mason Thinking and Writing Program on the Skills of Second Grade Children.* Princeton, New Jersey: Applied Educational Research, Inc., February 1985. 81 pages. ED 258 191.

One of the inherent challenges in any effort to instruct younger students in thinking skills is to find a way to make their thinking visible. At the upper levels, we most often evaluate students' thinking by looking at their writing; why not at the elementary level as well? Traditionally, "expository writing" is seldom mentioned in the same breath with "second grade." But as this study shows, we may be underestimating the writing (and thinking) potential of second-grade students.

The study assessed the effects of the Mason program (a supplementary language arts program involving expository writing) on such matters as the mechanics of writing, modes of expression, and related thinking skills. These skills were measured by standardized tests and by actual writing performance. The subjects, approximately 400 second-grade students divided into a treatment group (in the Mason program) and a control group, were tested at the beginning and the end of instruction.

Students in the program were asked to write in such a way that a humorous imaginary character named Mr. Magargle (who is easily confused and is always in need of help) can understand written explanations or instructions. The well-defined and structured lessons included specific instruction and practice in exercising a variety of thinking skills important in expository writing. These skills include classifying, presenting a logical sequence of ideas, and distinguishing between the necessary and the unnecessary. Students were taught to reread and correct their own work by checking it against a system of color-coded circles.

Results of the study indicated that, for most writing measures, statistically significant differences favoring the treatment group were found, especially in sentence quality and in the overall quality of responses to the writing assignments. In addition, the average differences in the treatment and control groups were larger for students with low initial scores than for those with higher scores. Hence there was less overall variation between high and low achievers in the treatment group than in the control group. As Jackson notes in regard to this finding, "it is often found in curriculum evaluation studies that effective programs increase the gap between the most and least able students. Contrary to that common result, these findings suggest that the Mason program is particularly helpful in improving the writing skills of less able students."

4 Rawl, Ruth K., and Frances S. O'Tuel. *Mathematics Achievement in Young Children Is Increased with a Cognitively Oriented Curriculum.* Paper presented at the annual meeting of the Southern Association on Children under Six, Charleston, South Carolina, March 10-12, 1983. 15 pages. ED 227 933.

While writing is one of the clearest indications of younger students' thinking skills, mathematics is equally important. Children often are taught mathematics entirely through drill and practice, without reference to any context that has meaning for the child. Accordingly, this study investigated three programs from different theoretical perspectives to determine which kind of mathematics program would produce the best results for kindergarten children.

The first program, behavioristic in focus, made use of texts, worksheets, and seatwork. The second, cognitive-developmental in outlook, stressed conceptualization of numbers and number systems through manipulatives, games, puzzles, simulations, field trips, and the frequent use of three-dimensional objects. The third program, labeled "eclectic," included total group responses, high structure, and much repetition. Activities included both textbook seatwork and some worksheets, along with games and simulations.

A total of ninety-six children from six public kindergarten classes in three schools in Fairbanks, Alaska, participated in the study. Results

revealed that the cognitive-developmental approach yielded significantly higher achievement in mathematics than did either of the other two approaches. The mean score for children in the behavioristic group was higher than that of the eclectic group, but the difference was not statistically significant.

These results are remarkable in light of the fact that children in the behavioristic program scored significantly higher before treatment and that twice as many adult instructors were present in this program as were present in either of the other two approaches. Clearly, cognitive and developmental strategies are every bit as appropriate in mathematics as they are in other areas of the primary curriculum.

5 **Williams, Belinda.** "Implementing Thinking Skills Instruction in an Urban District: An Effort to Close the Gap." *Educational Leadership* 44, 6 (March 1987): 50-53. EJ 353 790.

If instruction in thinking skills truly has the promise of simultaneously enhancing overall achievement and narrowing the gap between the highest and lowest achievers, as the above studies suggest, such instruction should be especially valuable in urban, low-income school districts with a high percentage of minority students. The achievement gap between these schools and more affluent schools generally widens as students move through the systems.

In an effort to reverse this chronic pattern, the Paterson (New Jersey) School District, whose enrollment is 90 percent minorities, has instituted an exemplary Cognitive Instruction Project (CIP) to improve academic achievement. The long-range plan was to start teaching thinking skills in all kindergarten classes in 1982, and then to add an additional grade each year. The first year, 2,000 kindergarten students were involved; when Williams wrote this article the program served over 8,000 students through the third grade.

The project was planned and designed by a group of forty educators in the district, including principals, curriculum supervisors, and classroom teachers, working in conjunction with the district's department of research and development. They incorporated a variety of prepackaged cognitive instruction materials, along with some of their own creation, that addressed specific identified skills, could be taught in thirty-minute lessons during language arts instruction, and required minimal staff development or preparation time.

Following these principles, the district put together a four-year curriculum from kindergarten through third grade, trained and monitored the teachers involved, and evaluated the results. They also made parental involvement a high priority by including parent workshops, take-home lessons to be completed by students and parents, and opportunities for parents to observe the children during their instruction in thinking skills.

Now in its fifth year, the program is reported to have resulted in steady improvement in the students' ability to comprehend and evaluate information. School officials say they have learned that organization, written instructions, and a systematic teacher support system, including monitoring, are essential to the program's success: "Only a structured plan, with support from the superintendent, curriculum supervisors, and principals, can accomplish the magnitude of change that we determined necessary," says Williams, who also notes that the program is "built upon a dedicated and persevering faculty and a belief in the learning potential of all students."

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